THE DIETETIC TREATMENT OF DIABETES MELLITUS.

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To one who has devoted much attention to the study and treatment of diabetes the difficulties that beset the general practitioner in an endeavor to arrange diets for these cases and to make the requisite analyses within the time available seems almost insurmountable. It is the object of this paper to present in a simple way such routine procedures as a clear understanding of the individual case demands and a scheme of diet tables which permits of that adaptation of food to the peculiarities of the individual without which no degree of success can be expected. The dietetic treatment of diabetes demands the same attention to detail that is required in the modification of milk for infant feeding, and on this account minutiæ will be set forth in this paper which to many will appear unnecessary.

Before proceeding further it is desirable to say a word regarding the detection of sugar in urine. When large amounts of sugar are present in the urine there is no likelihood of other substances being mistaken for it; but when less than 1 per cent. occurs this is not the case if Fehling's solution be employed, as it now generally is. I have seen three persons who had been told that they suffered from diabetes and who excreted no sugar in the urine, the reducing body being glycuronic acid. It should be remembered that reducing bodies other than glucose react with alkaline copper solutions; of these uric acid, glycuronic acid, and sugars other than glucose may occur in the urine in amounts large enough to lead to confusion. A urine which reduces Fehling's solution before, but not after fermentation, in all probability contains glucose. Occasionally one finds that the urine passed at one time of day has a little glucose in it, while none may be found in other samples from the twenty-four hour specimen. This is rather characteristic of a type of gouty individual; and the sugar excretion in such cases will be found to follow a meal when it is the man's habit to eat largely of sweets. For example, one patient had sugar in the urine passed during the night and it was found on inquiry that he usually ate considerable candy after dinner. These cases are not to be regarded as diabetics, although some of them doubtless become so. They should be cautioned and the total amount of food diminished, since they are always over weight.

In advising a diet for a diabetic, one has the following conditions to consider: (1) A diminished ability on the part of the diseased organism to assimilate carbohydrates; (2) a metabolism perverted in such a manner that fatty acids are no longer burned in a normal manner or to their normal end-products and in consequence of this acid bodies are developed which are toxic; and (3) a diminution of carbohydrate food to meet condition (1) predisposes and increases in degree condition (2). From these considerations it is evident that whatever is done in the way of diminishing the carbohydrate ingest must be effected with caution and with attention directed as much to the degree of acidosis as to the sugar output. On this account it is always advisable to change from a general diet containing a normal amount of carbohydrate to one that is poor in starch gradually; and this is especially the case with young patients. This aim is most easily effected by having some routine diet containing a definite and known amount of carbohydrate which may be gradually reduced as one proceeds with the case in hand. It is an advantage to begin with such a diet in each case because the differences of "reaction" give clues as to what may be expected from various therapeutic and dietetic procedures. The following is the diet I employ as a means of finding the type to which an individual case belongs:

"TEST" DIET.[1]

Breakfast:
    3 eggs with 25 grams of bacon.
    3 biscuits (Huntly and Palmer breakfast[2]) with 20 grams of butter.
    1 cup of strong coffee,[3] 25 c.c. of cream.

Dinner:
    1 cup of bouillon.
    100 grams of beefsteak or roast beef (weighed cooked).
    Boiled cabbage or cauliflower with butter sauce ad libitum; lettuce with oil and vinegar.
    25 grams of cream cheese.
    Coffee jelly with 25 c.c. of cream.
    3 biscuits with 20 grams of butter.

4 to 5 P.M.:
    Coffee or tea with 25 c.c. of cream.
    1 biscuit; 10 grams of butter.

Supper:
    100 grams of fish (weighed cooked).
    2 eggs.
    Asparagus as salad or hot (with butter sauce).
    3 biscuits; 20 grams of butter.
    1 dozen almonds.

This diet represents approximately 125 grams of protein and 100 grams of carbohydrate, and is equivalent to 3200 calories. It would be more than adequate were it not for the sugar loss through the urine, which for the time must be made good to prevent loss of weight.

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[1] Without bread this diet is practically free of sugar and is the "C. F." (carbohydrate-free) diet of these tables; variety is secured by changes from Tables A and B.

[2] Any bread or cracker that can be secured of uniform size and composition will serve as well.

[3] Crystallose is superior to saccharin as a substitute for sugar.

The patient should be restricted absolutely to this diet, for two days, the urine being collected during the *second* twenty-four hours, and estimations made for the quantity of glucose and the presence and approximate amounts of diacetic and β-oxybutyric acids.[4] The next step in the diet arrangement will depend exclusively upon this analysis, and it will serve best for clearness if concrete cases be used for illustration. The analysis may show any one of the following conditions:

1. Sugar less than 100 grams, ketone bodies in small amounts.
2. Sugar more than 100 grams, ketone bodies in small amounts.
3. Sugar less than 100 grams, ketone bodies in large amounts.
4. Sugar more than 100 grams, ketone bodies in large amounts.

A case representing the features of the first postulate still retains considerable ability to assimulate carbohydrate (less being excreted than the amount in the food), and is not suffering from acidosis. This is perhaps the least difficult type to deal with, and one in which success is probable. These patients are usually past middle age and the occasion for consulting a physician is the inconvenience of polyuria, pruritus, carbuncle, etc. The method to be observed in treatment is illustrated by the following case:

CASE I.—Mrs. E. C. G., aged fifty-six years.

1907	Diet.	Urine. Amount. c.c.	Sugar. Amount. Grams.	Acetone. Grams.	Diacetic acid. Grams.	β-oxy-butyric acid. Grams.	Weight. Pounds.
March 3	"Test"	1850	47.5	1.5	Trace	0	181
" 4	"C. F."	1920	38.0	1.8	Trace	0	
" 5	"C. F."	1570	11.0	Trace	0	0	
" 6	"C. F."	1580	Trace	Trace	0	0	
" 7	"C. F."	1250	None	Trace	0	0	180
" 8	"C. F."	1340	None	Trace	0	0	
" 9	"C. F."	1270	None	None	0	0	
" 10	"C. F."	1360	None	None	0	0	
" 11	50 grams bread	1370	None	None	0	0	181
" 12	50 grams bread	1290	None	None	0	0	
" 13	50 grams plus 25 grams equivalent in Table C.	1310	None	None	0	0	182

For the following ten days a choice was given of either 75 grams of bread or its carbohydrate equivalent in Tables C and D; at the same time substitutions were made in the "Test" diet for the meats and vegetables (Tables A and B) to give variety to the food. During this period no sugar appeared in the urine. The patient was then directed to send a twenty-four hour specimen of urine every third day and to continue the use of the diet which was by this time clearly understood by her. It will be noted that with abstractions from these tables suited to the locality and season the patient is given considerable latitude, and yet the carbohydrate fraction is kept within pretty definite limits.[5] It was found possible within the next two months by slowly increasing the allowance of carbohydrate, first to 85 grams, then by 10 gram increments, to allow 120 grams daily without sugar appearing in the urine. No attempt was made to arrive at a higher tolerance. This patient was in good health a year later and no sugar was excreted in the urine.

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[4] The polariscope should not be depended upon for estimating sugar in diabetic urines as the error introduced by the presence of diacetic acid may be very considerable. There are modifications of the titration methods that make it possible to secure more accurate results than the polariscope gives and that require no more time or skill. Benedict's modification of Fehling's solution works admirably with a very sharp end point. The method will shortly be published in the *Journal of Biological Chemistry*. Citron's method or Gerhart's are quickly and easily done. The determination of ketone bodies is an operation that demands considerable laboratory apparatus and some experience in chemical processes; no method thus far devised yields better than approximate results. Quite as much information—if not more—can be gained from ammonia estimations which are easily made and require very little apparatus or skill.

As an illustration of the second type in the classification (sugar more than 100 grams; ketone bodies in small amounts) the following case will serve us:

CASE II.—F. B., aged forty-two years. He has had diabetes three years, and has lost much in weight; of late he has been unable to work on account of weakness.

Date.	Diet.	Urine. Amount. c.c.	Sugar. Amount. Grams.	Diacetic acid. Grams.	β-oxy-butyric acid. Grams.	Weight. Pounds.
Feb. 8	"Test"	3100	186.0	None	None	104
" 9	75 grams bread	2800	111.0	None	None	
" 10	75 grams bread	2500	93.0	None	None	
" 11	"C. F."	1160	25.3	None	None	
" 12	"C. F."	1170	20.9	Trace	None	106½
" 13	"C. F."	1250	12.1	4.4	Trace	
" 14	Oatmeal	1180	29.4	2.3		
" 15	Oatmeal	1210	20.0	None	None	
" 16	Oatmeal	1240	1.3	None	None	
" 17	Oatmeal	1190	None	None	None	106¼
" 18	Breakfast, oatmeal and cream	1070	None	None	None	
" 19	Lunch and dinner.	1290	None	None	None	
" 20	"C. F." + 50 grams oat cakes.[6]	1185	None	None	None	
" 21		1240	None	None	None	109
" 22		1220	0.9	None	None	
" 23		1140	None	None	None	
" 24		1030	None	None	None	109
" 25		1280	None	None	None	
" 26		1265	None	None	None	

It will be noted that at the beginning of the treatment there seemed to be no tolerance for carbohydrates, much more being eliminated in the urine than could be accounted for in the diet. On a carbohydrate-free diet, however, the sugar excretion rapidly fell and it appeared that the urine would have been free of glucose in a few days had the diet been continued. With the diminution in sugar excretion, however, there was an increase in acetone and diacetic acid, and the patient's condition suggested that more acids were retained than were excreted. At this juncture (February 13) two lines of procedure were open: (*a*) Alkalies might have been used to aid in the acid elimination and the same diet continued. Under these conditions—a falling sugar excretion with a slight grade of acidosis—the ketone bodies often disappear from the urine along with the sugar; the explanation apparently being that with regained ability to burn sugar the normal metabolism of the acids takes place also. In many cases small doses of alcohol at this time help to the desired end. The other alternative in treatment was, (*b*) the use of oatmeal, which is one of the surest means of combating acidosis and in many cases also decreases the sugar excretion as well. (The details of the oatmeal "cure" will be entered into later in this paper.)

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[5] A suitable balance with weights may be purchased for about $5.00.

[6] Receipt for preparation at end of this paper.

This diet—oatmeal and cream for breakfast; lunch and dinner from Tables A and B, plus 50 grams of oat cakes—was continued for two weeks, February 18 to March 4; then 40 grams of white bread was allowed on alternate days, but one day in each week was kept carbohydrate-free, neither bread nor oatmeal being permitted. As no sugar appeared in the urine during this experiment and the patient liked the diet he was ordered to continue its use indefinitely; the carbohydrate-free diet list given him being made up of Tables A and B. His urine showed sugar but twice during the next three months, analyses being made every third day. He then left town and was lost sight of.

The object of reserving one day at fixed periods on which no carbohydrate is to be eaten, is that by so doing the tolerance for carbohydrate is not strained. It is, so to speak, a rest day for a special function. The indication for this occasional rest is shown in the fact that amounts of starch which are metabolized perfectly at the commencement of a given diet, may after an interval, induce a glycosuria, at first slight but daily increasing until the larger part of the carbohydrate eaten is promptly excreted.

It occasionally happens, of course, that oatmeal is not well tolerated in cases of the above type, the sugar output increasing rather than diminishing after its use. This, in my experience is exceptional; an initial rise in the sugar excretion is common, but in a few days it rapidly subsides. When, however, oatmeal is found detrimental, the method already mentioned is usually effectual in patients past middle life—carbohydrate-free diet, with alkalies to combat mild acidosis. After there is no longer loss of glucose through the urine we must proceed to build up a dietary by adding small known amounts of starchy foods, as in the cases already described, keeping these amounts within the assimilation limit of the patient and interpolating at definite periods carbohydrate-free days to aid in preserving any tolerance established.

With patients younger than the last case the difficulty is usually not so quickly nor easily overcome, although the acidosis may not be alarming early in the course of the disease. The next case to be considered comes under the same classification as the last one—sugar excretion more than 100 grams, ketone bodies in small amounts—but is much more severe and intractable to treatment.

CASE III.—S. A., aged twenty-nine years; complains of thirst and weakness. In May, 1908, he noted that he was losing flesh and strength. He improved a little during the summer without seeing his physician. He was refused insurance in September, 1908, and was told he had diabetes. He has lost about forty pounds in eight months. He has a splendid appetite, and drinks over a gallon of water a day.

Date.	Diet.	Urine. Amount. c.c.	Sugar. Amount. Grams.	Diacetic acid.	β-oxy-butyric acid.	Weight. Pounds.
Jan. 1	Standard	4200	310	+ +	None	112
" 2	"C. F." + 75 grams bread	3400	287	+ +	None	
" 3	"C. F." + 75 grams bread	1500	111	+	None	
" 4	"C. F." + 35 grams bread	1900	129	+	None	
" 5	"C. F." + 35 grams bread	2000	112	+	None	112½
" 6	"C. F." + 35 grams bread	3400	122	Trace	None	
" 7	"C. F." + 35 grams bread	1400	74.3	Trace	None	
" 8	"C. F." + 35 grams bread	1380	81.0	Trace	None	
" 9	"C. F." + 35 grams bread	1850	70.4	Trace	None	114
" 11	"C. F." (No bread)	2400	79.0	Trace	None	
" 13	"C. F." (No bread)	2475	81.6	+	None	
" 15	17th & 18th "green	2100	63.0	Trace	None	
" 18	days"	1450	15.5	+	None	115½
" 21	19th, 20th & 21st oatmeal days	1450	29.0	+	None	
" 24	"C. F." + oat cakes, 30 grams	500	2.5	+	None	
" 26	"C. F." + oat cakes, 30 grams	600	None	Trace	None	
" 27	"C. F." + oat cakes, 30 grams	950	8.5	+	None	
" 28	"C. F." + oat cakes, 30 grams	2470	9.9	+	None	115½
" 29	+ 20 grams bread	2100	8.4	+	None	
" 30	+ 20 grams bread	3100	27.8	Trace	None	
" 31	+ 20 grams bread	2300	18.4	+	None	
Feb. 1	+ 20 grams bread	1775	19.5	+	None	
" 6	20 grams bread	1800	20.6	+	None	
" 9	20 grams bread	1950	8.0	+	None	
" 15	20 grams bread	2100	17.0	Trace	None	
" 21	20 grams bread	1710	None	None	None	
" 27	20 grams bread	1690	3.4	None	None	126
March 3	40 grams bread	1480	None	None	None	
" 15	40 grams bread	1520	None	None	None	135

It is to be noted here that sugar was still excreted in large amounts after five days of starch-free diet (January 10 to 15) and that three "green days" did not rid the urine of sugar. There was a rapid fall when small amounts of oat cakes were allowed along with the carbohydrate-free diet, but an immediate rise when wheat bread was substituted; indicating that only a very slight tolerance existed. The sole encouraging feature in the case was that the acidosis remained an almost negligible factor. Inasmuch as with young individuals exemplified by this case there is a marked tendency to acidosis, which must be constantly had in mind, it was not advisable to withhold starch from the diet for any prolonged period. On that account the following routine was advised to be continued for one month: One day, foods from Tables A and B, plus 30 grams of bread; two "green days;" and one oatmeal day. These days were to alternate in their above order, bread day, "green days," oatmeal day, then bread day, and so on. The urine was collected during each "bread day" which represented the maximum excretion of sugar it was found. The object of this arrangement of diet was to reduce sugar excretion by means of the "green" day and "oatmeal" day; to counteract any tendency to acidosis arising from the starvation of the "green days" by the oatmeal day and to keep up the general nutrition if possible, by means of the more liberal "bread" day. The result was so satisfactory to the patient at the end of the month that he desired to continue in the routine a while longer. At the end of three months the amount of bread had been gradually increased to 90 grams without sugar in the urine. This with its equivalents (Table C) made a considerable relaxation from the strictness of the diet on the other days.

In a case like the above nothing can be accomplished, nor should be expected, without the full coöperation of the patient. The diet, at best, is irksome and a fixed routine most disagreeable to many temperaments. Still there are but a few of the laity who do not realize something of the gravity of the disease, and this together with the amelioration of the torment of constant hunger and thirst and the increase in strength and sense of well-being render the majority of patients eager coöperators with their physician.

One word here with regard to what may be hoped for in diabetics like the last case. A minority develop after a year of treatment considerable assimilative power for carbohydrates—100 grams of bread. This is often retained for several years, but eventually becomes broken down either because of their own disregard of directions or of a too optimistic medical adviser. The majority even under strict supervision slowly lose their tolerance and in the course of a few years arrive at a condition where little if anything can be done for them. The benefit of treatment is solely in postponing the latter state and prolonging for a period some semblance of health compatible with activity and enjoyment. Very exceptionally, I think, these cases live for a decade or over even though the disease has begun when the patient was under thirty. I have knowledge of but one such case, a man who first learned of his diabetes when he was twenty-four and died at the age of forty.

The class of diabetes in which acidosis is a prominent symptom demanding constant attention and regulation of diet next requires attention. These cases for the most part are to be regarded as a later stage in the type already discussed and the greatest care is demanded by the younger patients, since they not only develop alarming grades of toxemia very quickly but also withstand it poorly.

The following case is an example of this type:

CASE IV.—J. B., aged twelve years. The patient was a healthy girl until about a year ago when she began to have great thirst, an abnormally increased appetite, and to lose in weight. The family physician found sugar in the urine and ordered a diabetic diet, which caused the child to improve for a while, but she soon was as bad off as before, and the parents in consequence brought her to the hospital. On admission the child looked flushed and toxic, and the first urine voided was found to give an intense reaction for diacetic and β-oxybutyric acids. Oatmeal diet was directed in an amount sufficient to give adequate calories for nourishment: oatmeal, 6 ounces; butter, 1½ ounces; 2 eggs; water, 24 ounces; 6 ounces of this gruel was given every four hours.

Date.	Diet.	Urine. Volume. c.c.	Sugar. Grams.	Acetone + diacetic Grams.	β-oxy-butyric acid. Grams	Nitrogen.	Ammonia.	Weight. Pounds.
March 10	Oatmeal	2700	175.0	1.47	2.65	12.89	2.02	51
" 11	Oatmeal	1400	70.0	1.18	1.70	8.51	1.40	
" 12	Oatmeal	780	15.6	0.18	0.11	3.9	0.80	
" 13	Oatmeal	850	0.8	0.40	0.38	7.6	0.81	
" 14	Oatmeal	760	Trace	0.25	0.21	7.1	0.80	52
" 15	"C. F."	810	None	0.19	0.26	9.1	0.86	
" 16	"C. F."	840	Trace	0.17	0.25	9.7	0.88	
" 17	"Green day"	790	None	0.28	0.20	6.9	0.92	52¼
" 18	Oatmeal	750	Trace	0.20	0.13	7.5	0.81	

It is unnecessary to continue the table further, as the above gives an adequate idea of the patient's condition. The urine could not be freed of sugar for more than a day at a time, because the necessary restrictions induced a prompt increase in ketone bodies. All that was accomplished in the above case after a month's treatment was a gain in weight and a marked increase in sense of well-being to the patient. No substantial tolerance for carbohydrate was established nor could be expected. If we can make such individuals comfortable we must be satisfied in the present state of our knowledge and by doing so we are able to prolong life. The following case was one of the most severe I have seen, and from the first hopeless, yet the child was kept sufficiently well to enjoy life until the day before she died—a period of two and a half years.

Case V.—C. G., aged four years, was brought by her father who also had diabetes and had had Graves' disease. Sugar was first found in the child's urine in December, 1907. At first, by careful supervision, the urine was kept almost constantly sugar free during the winter and spring of 1907 and 1908, allowing 25 to 30 grams of bread. At this time there was no tendency to acidosis. During the summer of 1908, no sugar was excreted for sixty days, but the tolerance had diminished, as it continued to do gradually until in October, 1908, a carbohydrate-free diet was necessary to secure glucose-free urine. On a diet of 8 grams of rice in the morning and 8 grams of zweiback at noon and night, 7 grams of glucose appeared in the urine. A slight grade of acidosis first made its appearance at this time, but a satisfactory condition was maintained until January, 1909. Then, coincident with otitis media an alarming degree of acidosis suddenly developed, as evidenced by symptoms and urine analyses. Ten days of exclusive oatmeal diet was necessary to carry the patient through this complication. Following the recovery from the otitis media it was found that the glucosuria could be controled only by the use of "green days" in alternation with oatmeal days for the acidosis. The routine was one vegetable day followed by two days of liberal diet on which definite amounts of starchy foods were allowed. Then again a vegetable day, two oatmeal days, a vegetable day, and so on. With this regimen the patient regained the weight lost during the acute illness and appeared very well until early spring of 1909. From April, 1909, the urine could not be longer freed of sugar and the amount of ketone bodies excreted seemed to threaten toxemia, although the child appeared quite well usually and played with other children a large part of each day. Oatmeal no longer produced any effect on the glycosuria and because of abdominal distention and pain, which it appeared to induce, was abandoned as a gruel and used only as cakes with other food.

Date.	Diet.	Urine. Amount. c.c.	Sugar. Amount. Grams.	Acetone + diacetic Grams.	β-oxy-butyric acid. Grams.	Total N.	NH_3 N.
Oct. 19, 1908	8 grams rice and zweiback 16 grams	800	6.21	0.55	0.14	7.1	0.70
Apr. 22, 1909	Vegetable day	1260	13.40	0.29	0.38		
" 26,	Oatmeal	3240	106.4	1.88	0.20		
" 29,	"C. F." + levulose apples	2935	85.1	3.25	5.88	11.44	2.39
May 2,	Oat cakes	2400	84.9				
" 6,	Oat cakes + apples	2520	64.7	2.69	4.16	9.12	2.22
" 12,	Graham cakes + apples	1830	67.7				
" 20,	Oat cakes	2500	46.0	4.35	4.74	10.44	2.12
" 26,	Oat cakes	2490	65.0				
June 7,	Oat cakes	3200	81.0				
" 20,	Oat cakes	2500	48.2	2.93	6.96	11.15	1.88
July 5,	Oat cakes, alkalies	2000	50.0	3.06	3.70	6.01	1.42
" 10,	Oat cakes, alkalies	2300	98.9			3.84	0.55
" 14,	Oat cakes	2000	106.0	3.14	6.52	3.24	0.58

Coma supervened on July 20 and resulted fatally on the following day. Infusion with alkalies was not considered on account of the hopeless condition of the child before coma began. This case represents the severest and most desperate manifestation of diabetes, especially when it occurs in so young a person. And it must be confessed that this child owed her two years of life as much to the intelligent care and resourcefulness of the mother as to her physician.

The cases that have been cited serve to show the methods that may be employed to meet definite indications. I have called them typical, but it is to be understood that type is meant only in the gross sense. Every case of diabetes is peculiar in some or perhaps all of its features and so there are no types in an exact sense. The secret of treatment is the individual treatment, the adaptation of methods to the peculiarities of each case. There is no diet adapted to all, not even to all of a gross type.

ACIDOSIS. As acidosis is the complication most to be feared in every case of diabetes the subject demands more than a passing word.

Despite every care that we know how to exercise, many diabetics develop a severe degree of acidosis which sooner or later terminates life. It is not yet clear whether the development of ketone bodies is to be interpreted as an entirely abnormal type of metabolism, or whether these substances are intermediate metabolic products which the diseased organism cannot split in the normal manner to their proper end products: CO_2 and water. The source of β-oxybutyric acid (the mother substance from which diacetic acid and acetone are derived) is mostly from the fatty acids. It is conceivable that any streight chain fatty acid with an even number of carbon atoms in its molecule may break down into butyric acid, and for many such acids the fact has been demonstrated. In a less degree, but doubtless to some extent, protein may also give origin to the ketone bodies, since the amino-fatty acids are readily disamidized in the body and are then to be regarded as simple fatty acids.

As a usual thing, it is far easier to postpone the initial development of acidosis than it is to cope with the pronounced condition once it has become fixed. But I am convinced that the feeding of carbohydrate food when such food is not assimilated, but passes through the body into the urine does not in any way delay acid toxemia. Carbohydrates that are burned, on the contrary, do prevent acidosis, causing the acids, it may be, to be burned also. It is for this reason probably, that the oatmeal diet acts so well in many cases of acidosis. The carbohydrate in this case is burned, and in those individuals who retain for some time a carbohydrate tolerance, it is to be noted that the acidosis does not reach an alarming degree until such tolerance has utterly failed. There are some features of this intoxication that find analogies in inanition; for example, the excretion of ketone bodies reaches a surprising extent in many cases of gastric ulcer under the von Leube treatment.

When no bread or its equivalent can be allowed without the appearance of corresponding amounts of sugar in the urine the interpolation of oatmeal days is the best way to proceed. Later in the course of the disease several such days may be necessary and in a few cases I have ordered this diet unremittingly for two weeks. In some cases the appearance of ketone bodies in the urine may be quickly checked by the addition of alcohol in some form to the dietary.[7] In these, strange as it may seem, the tolerance for carbohydrate appears improved by this measure.

This is perhaps as good a place as another to speak of levulose. As is well known, some diabetics can assimilate this sugar when not able to use any other, and on this account it has been much over-used by physicians. The tolerance for levulose is never large and is invariably short lived if the sugar be constantly eaten. On that account it should be employed in small amounts and never constantly. In Germany, a levulose chocolate is much used as a confection for diabetics and satisfies that hunger for sweets which many have. It is also convenient with fruits, apples, cranberries, currents, to manufacture marmalades and preserves. Levulose, if used discreetly, is a valuable aid in preventing acidosis, but it is an aid only so long as it is metabolized.

In spite of the best of care the majority of the younger cases of diabetes will sooner or later develop severe grades of acidosis, evidenced not only by the ketoneuria but by loss of appetite and somnolence. For this, besides the diets already mentioned, we have to resort to large doses of alkalies, sodium bicarbonate alone or mixed with a quarter to half its weight of citrate. Some patients prefer to take the alkalies in capsules, others find them not too unpleasant when dissolved in water.

A final word with reference to infusion with alkalies in diabetic coma. Enormous quantities of alkalies are often required to produce any effect. It is advisable to use 4 per cent. sodium bicarbonate solution and to repeat the procedure until 100 grams has been administered. As soon as possible, if consciousness returns, alkalies should be given by the mouth also. The length of life following a successful treatment of coma is in the vast majority of cases so brief that the operation is not suited to every case. It hardly seems justifiable, for instance, in the case of children when all that may reasonably be expected is a few days more of precarious existence.

Diet Tables. In an attempt to arrange a dietary for a diabetic it is necessary to give as much variety in foods as possible. If this be not considered the patient becomes disheartened with the restriant, the appetite fails, and he loses in weight and strength. In the following tables the effort is made to gain the greatest possible variety and at the same time to control absolutely the carbohydrate ingest. Tables A and B are made up of foods that are nearly carbohydrate free and from these lists this sort of dietary may be constructed according to the patient's preferences. These foods (Tables A and B), may be used without restriction of quantity unless there is a necessity of limiting the amount of protein consumed. In Tables C and D the foods all contain carbohydrate. These tables are to be used only when the carbohydrate tolerance of the patient is known, and then the total amount of starch-containing food should be kept well below the tolerance limit (by at least 10 grams of bread). For example, if 60 grams of white bread is assimilated without inducing glycosuria, then not more than 50 grams in equivalents should be allowed. Further, foods like potatoes and fruits should be separately tested with each patient in order to determine whether there is any peculiarity of reaction toward them respecting sugar excretion.

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[7] This was first called to my attention by a case of Friedrich von Müller at his Munich clinic

The order and number of meals requires consideration also; four or five meals are better than three; a second breakfast and afternoon tea may be interpolated. Half of the daily allowance of bread should be taken at the mid-day meal and it is better that at least a third of the daily bread allowance be used as equivalents —vegetables and fruits.

TABLE A.

Fresh Meats: All muscle parts of beef, veal, pork, lamb, mutton, domestic, and wild fowl, either roasted, boiled, or broiled, in their juices, with butter, or with mayonnaise made without flour, either hot or cold.

Various Organs of Animals: Tongue, heart, brains, sweetbreads, kidneys, marrow, calves' liver, liver of game or poultry (pate de fois gras) up to 100 grams in weight, weighed after being prepared.

Preserved Meat: Smoked meat, dried meat, smoked or pickled tongue, ham or bacon, corned beef, sausage (containing no bread). Be sure that no flour is used in preparing pickled meats.

Meat peptones of all kinds, jellies, or aspics prepared from calves' feet, or pure gelatine; nutrose, tropon, plasmon, wheat gluten, etc.

Fresh Fish: All fresh fish boiled, fried, or broiled. If the fish is fried in bread crumbs and eggs the crust should be removed before the fish is eaten. All sauces that contain no flour are allowed; those that contain butter and lemon are the best.

Preserved Fish: Dried, salted, and smoked, such as haddock, cod, herring, mackerel, flounder, sturgeon, eels, salmon, etc. Pickeled herrings, sardines in oil, mackerel in oil, anchovy, tunnyfish, etc.

Fish Products: Caviar, cod-liver oil.

Shell Fish and Crustacea: Oysters, clams, and other shellfish, lobsters, crabs, crawfish, shrimps, turtle, etc.

TABLE B.[8]

Foods Rich in Fats: Dairy products—cream, butter, yolks of eggs, cheese.

Animal fats—bone marrow, fat of edible meats, lard, tallow (used in cooking), cod-liver oil, oleomargarine. *Vegetable fats*—olive oil, cottonseed oil, peanut oil, peanut butter, nut butter.

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[8] These tables are based on the composition of foods as given in Bulletin 28, United States Department of Agriculture, and on the Nährungsmittel Table of Schall and Heisler.

Vegetables containing a slight amount of carbohydrate (less than 4 per cent.). These may be taken in normal quantities unless otherwise directed: Asparagus, 2 per cent.; beet greens, 3.2 per cent.; Brussels sprouts, 3.4 per cent.; cabbage, 4.8 per cent.; celery, 3.3 per cent.; chard, 3.4 per cent.; cucumbers, 3.1 per cent.; endive, 2.2 per cent.; lettuce, 2.9 per cent.; sauerkraut, 3.8 per cent.; spinach, 2.8 per cent.; string beans, 1.9 per cent.; tomatoes (fresh), 3.9 per cent.

TABLE C.—Foods Containing Carbohydrate and to be Used Only in Restricted Quantity.

	Grams.	Grams.	Grams.	Grams.
White bread	10	20	30	50
	Equivalent to	Equivalent to	Equivalent to	Equivalent to
Corn bread	12	24	35	60
Graham bread	10	20	30	50
Gluten bread	13	26	39	65
Oat cakes	25	50	75	125
Wheat flour	8	16	24	40
Hominy (boiled)	20	38	50	
Rice (boiled)	14	28	42	
Tapioca (pudding)	15	30	45	
Macaroni (cooked)	30	60	90	
Spaghetti (cooked)	30	60	90	
Cocoa (unsweetened)	12			
Vegetables:				
Asparagus (cooked)	175	350[1]		
Beans, red kidney	25	50		
Beans, lima	25	50		
Beets (cooked)	55	100		
Cabbage (raw)	78	156		
Carrots (raw)	60	120		
Celery (raw)	100	200		
Corn, green, canned	25	50		
Cauliflower (raw)	80	160		
Dandelion greens	50	100		
Egg plant (cooked)	90	180		
Onions (boiled)	90	180		
Peas, green (cooked)	30	60	90	
Parsnips (raw)	40	80		
Potato (boiled)	25	50	75	
Fruits:				
Apples (raw)	35	70		
Apricots (stewed)	40	80		
Bananas	25	50		
Blackberries (fresh)	35	70		
Cherries (fresh)	25	50		
Currants (fresh)	40	80		
Grape fruit	200			
Gooseberries	75	150		
Oranges	30	60		
Peaches	50	100		
Pears	40	80		
Plums	27	54		
Prunes (stewed)	25	50		
Raspberries	42	84		
Strawberries	60	120		

[1] When no equivalent amount is mentioned in the third column, it is to be understood that the amount given in the second column is the maximum allowable.

TABLE D.

This table consists of a list of food materials which are not entirely free of sugars. They are allowed in quantities stated unless the patient is on a "carbohydrate-free" diet, when they must be avoided.

Vegetables (cooked without flour or sweetening): Dried peas and beans, either whole or in puree, turnips, carrots, salsify, green peas, lima beans, kidney beans, 2 tablespoonfuls.

Fresh Fruit: Apples, pears, apricots, peaches, 50 grams. Raspberries, strawberries, red currants, 1 large tablespoonful. Blackberries, 2 tablespoonfuls.

Stewed Fruit (with saccharine or crystallose): Plums, apples, pears, apricots, peaches, sour cherries, prunes, 1 heaped teaspoonful. Raspberries, gooseberries, red currants 2 heaped tablespoonfuls.

Dried Fruit: Plums, apricots, peaches, apples, prunes, 2 heaped tablespoonfuls.

Levulose chocolate (Stollwerck's) up to 15 grams.

Cocoa (without sugar) up to 12 grams.

HOW TO MAKE USE OF TABLE C.

The food is divided into two parts: (1) That which is free from carbohydrates, the principal fare, Tables A and B; and (2) that which contains carbohydrates, the secondary fare, Tables C and D. For instance, 75 grams of wheat bread are allowed in courses from Table C.

Breakfast: Principal fare, medium strong coffee or tea, cold meat, 1 egg and butter; secondary fare, 50 grams of oat cakes, the equivalent of which = 20 grams of wheat bread.

Second Breakfast: Two eggs in any form.

Dinner (mid-day meal): Principal fare, broth with egg, meat with green vegetables or salad (Table B), cheese and butter. Secondary fare, 50 grams of potatoes (= 20 grams of wheat bread), 60 grams of strawberries (= 10 grams of wheat bread).

Afternoon Meal: Tea, coffee, or consommé, with casoid cakes.

Supper: Principal fare, plenty of hot or cold meat, with vegetables or salad, cheese and butter; secondary fare, 25 grams of Graham bread (= 25 grams of wheat bread). Total, = 75 grams of wheat bread.

Oatmeal Diet. There is, at present, no scientific reason for the peculiar effect that oatmeal exercises on many diabetics; it is, however, true that in many cases in which large amounts of sugar are being excreted on a carbohydrate-poor diet, the institution of an exclusive oatmeal diet will result in the course of a few days in a sugar-free urine. This I have found most frequently in young diabetics, in whom the change effected by a week's treatment is sometimes wonderful, but it is in these very instances that one must not allow relatives of the patient to be deceived by the brightness of the outlook. The oatmeal diet is by all odds the best method of treating acidosis, and on this account it is not contraindicated in any type of case. Quite commonly with new cases in which there is some toxemia it is the best food to use for a few days, and leads the way to other methods. The chief obstacle that is encountered in the prolonged use of oatmeal is the intestinal derangements that ensue therefrom, taking the form of diarrhœa or severe constipation, and usually associated with marked tympanites. These symptoms are more prone to occur in children than with adults, but I have observed this only when the oat "cure" had been continued for over a week without intermission.

The most expedient mode of employing the oatmeal diet is as follows: An adult diabetic requires 16 calories of food value per pound body weight; if the patient weighs 150 pounds, he would need 2400 calories. Five ounces of butter—as much as can be well taken—is equivalent to 1125 calories which leaves 1275 to be made up by the oatmeal. One ounce of dry oatmeal is equal to 113 calories, or 11 ounces to 1230 + calories. This amount (11 ounces) is weighed out and put into three pints of water, slightly salted, and thoroughly cooked for at least six hours; then while still hot it should be strained through a sieve. If the cooking is thoroughly done only the coarse covering of the kernel will remain on the sieve. The butter is added while the thick porridge is still hot and stirred into it. This is one day's food and may be taken, equal fractions—about seven ounces—every two hours or a larger allowance less frequently. No other food is to be permitted except a little black coffee or some brandy. This diet may be used three or four days at intervals without any hardship; longer periods require some fortitude on the part of the patient and firmness from the medical adviser.

Green Days. The object of the "green" or "vegetable" day is to decrease the food ingest, chiefly the protein factor. This is demanded in some cases because the ability to utilize carbohydrate is so slight that not even that resulting from the breaking down of the protein molecule is not burned. A "vegetable" day is then an attempt to put completely at rest a certain function, and in making up the dietary for such a routine the less protein entering into the food the better; of course, all carbohydrates are excluded. The bulk of food taken, therefore, is fat, and as this is of necessity small, a vegetable day amounts to the starvation days advised by Naunyn, with a thin disguise. The vegetables that may be used in this diet are any of the green variety that contain little or no carbohydrate other than cellulose (Table B); of these spinach, celery, cabbage, beet-tops, and the salads serve best. These may be varied to suit the taste of the patient.

The vegetable day might be ordered as follows:

Breakfast: A cup of coffee, a teaspoonful of cream, 3 egg yolks, served as omelet, with tomatoes and parsley.

Luncheon: 1 cup of bouillon; asparagus with egg sauce.

4 P.M.: A cup of coffee or a glass of wine with 1 casoid biscuit.

Dinner: A cup of bouillon; 1 box of sardines;[10] spinach (boiled); 1 glass of wine or whisky.

Vegetable days are prone to increase markedly the formation of ketone bodies, and on this account, if the patient's urine shows the ferric chloride reaction before the diet is commenced, alkalies should be given during the vegetable day; 25 grams of a mixture of equal parts of sodium bicarbonate and citrate is usually sufficient. Vegetable days have their function in diminishing the sugar excretion, and in order completely to free the urine from sugar several vegetable days may be necessary.

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[10] The smoked Norwegian sardines are much more satisfactory than the other varieties on account of the flavor.

When this is the case, however, a most careful urine analysis is necessary daily to determine the degree of acidosis. When severe grades of ketonuria are caused by these "green days" it is best to follow them with one day of oatmeal. The number of days of each variety of diet (that is, vegetable days, "green days" and carbohydrate days), is a matter which must be determined by experiment with each individual.

Finally, it should be realized that the sugar output and acidosis are not the sole features on which success is to be judged. Patients must be frequently weighed and a constant loss of weight in a young person is quite as bad an omen as a large sugar output. Even with the most rigid diet regimen the nutrition should be maintained.

The dietary of the diabetic often seems to him extremely limited, and this can only be helped by variety in the manner of cooking foods. The receipts here appended are for the most part contributions from the families of patients.

SOUPS. *Consommé:* 3 pounds of beef from the round, 1 small knuckle of veal, 5 quarts of cold water—simmer four hours, then add: 1 pound each of carrots, turnips, and onions cut into dice, 1 teaspoonful of salt, ½ teaspoonful of sweet marjoram, ½ teaspoonful of thyme, 1 teaspoonful of peppercorns, 1 bay leaf, 1 sprig of parsley. Simmer one hour, strain and cool; when cold skim off the fat.

Consommé with Brussels Sprouts: To three pints of hot consommé add 2 cupfuls of Brussels sprouts which have been soaked in cold water twenty minutes, and boiled in boiling salted water fifteen minutes.

Consommé with Claret: To 1 pint of consommé add 1 pint of claret, 1 pint of hot water, pour 1 cupful of consommé over the yolks of 3 eggs; cook until the spoon is coated; add the beaten egg whites. Mix and serve either hot or cold.

Consommé with Cucumbers: To 3 pints of consommé add 2 sliced cucumbers which have been cooked one-half hour in 1 cupful of water. For the cucumbers may be substituted, red or white cabbage, cauliflower, asparagus, cooked meats chopped, or Parmesan cheese.

Tomato Soup: Stew tomatoes with butter, strain, and add an equal quantity of consommé.

Jacobin Cubes: Beat 3 eggs in a bowl, add some nutmeg and 3 teaspoonfuls of water; place the bowl in boiling water until the mixture thickens; cut in cubes and serve in broth.

For pureés, rub through a sieve cooked cauliflower, asparagus, or tomatoes; add to 3 pints of hot consommé and pour over 1 cupful of cream in which 2 egg yolks have been stirred.

SAUCES. *Cucumber Sauce:* Cut up 2 cucumbers in cubes after removing the seeds, stew them in 1 cupful of sour cream until soft. Stir up 1 egg yolk with 1 cupful of cream in a double boiler until it thickens; add this to the cucumbers and heat again; season with salt and peper.

Sauce Tartare: Slowly stir 1 egg yolk adding ½ cupful of olive oil, drop by drop, 2 tablespoonfuls of vinegar, also by drops, salt, pepper, 1 teaspoonful of French mustard and a little parsley. Stir on ice.

Mustard Sauce: 1 pound of melted butter, 1 pound of French mustard covered with broth, ¼ teaspoonful of salt, 1 teaspoonful of vinegar, take off the fire and beat in 1 yolk.

Horseradish Sauce: Stir a piece of butter with 2 tablespoonfuls of grated horseradish, add pepper and salt, cover with broth, and boil for one-half hour.

Brown Onion Sauce: 2 onions chopped and stewed in butter until brown, covered with broth, 1 teaspoonful vinegar, pepper, a clove, a bay leaf, a slice of lemon.

Sauce Bearnaise: Cook in double boiler, stirring constantly, 3 egg yolks, 1 teaspoonful of water, 1 teaspoonful of butter; add one at a time, 4 tablespoonfuls of butter; stir until boiling, and add 1 teaspoonful each of tarragon, or plain vinegar, tarragon leaves, and parsley minced.

Tomato Sauce: Tomatoes after being passed through a sieve are stewed in butter and covered with broth.

Mushroom Sauce: Mushrooms are stewed in butter and covered with broth or gravy. Take off the fire and beat in 1 yolk.

White sauce for asparagus, artichokes, etc.: Mix 1 tablespoonful of butter, 2 yolks, and 1 cupful of cream, cold; cook in a double boiler, beat constantly until thick. Serve immediately.

Spinach Pudding: Mix with 1 quart of boiled spinach 4 yolks, add ½ onion, ½ cupful of cream, whites whipped stiff, and ½ cupful of ham cut in cubes. Place the mixture in a well-buttered dish and steam in a "bain Marie."

Baked Cauliflower: Place soft boiled cauliflower in an open pie dish, pour sour cream, melted butter, and parmesan cheese over it; then bake in the oven.

Tomato Jelly Salad: To one can of stewed and strained tomatoes, add 1 teaspoonful of salt and ⅔ box of gelatin soaked and dissolved. Pour into small cups and chill. Serve on lettuce leaves with mayonaise dressing.

Oatmeal Muffins: To 2 half-pint-cupfuls of finely ground (coffee grinder) oatmeal add 1 heaped teaspoonful of Royal baking powder and ½ teaspoonful of salt. Mix well, add 1⅓ cupfuls of cold water, and at last a piece of melted butter (or lard) the size of an egg. Beat well for a minute, put in muffin tins, and bake in a hot oven.

Coffee Mousse: 1 quart of thin cream; 1 cupful of strong coffee; 1¼ tablespoonfuls of granular gelatine; 2 tablespoonfuls of cold water; 3 tablespoonfuls of hot water, and saccharine to taste. Add the gelatine soaked in cold water and dissolved in boiling water to the coffee. Set the mixture in a pan of ice water and stir until it begins to thicken; then fold in whipped cream, put in mold cover, pack in equal parts of salt and ice, and let stand four hours.

Stuffed Eggs: Mash up the yolks of 5 hard-boiled eggs with a lump of butter, thicken with parmesan cheese, 1 raw egg, and some sour cream. Fill the whites of the 5 eggs, tops and bottom with this mixture, place in a buttered tin, sprinkle with cream and cheese, and bake in the oven.

Ragout Eggs: Mash the yolks of 6 hard-boiled eggs with a fork, slice 2 onions and stew them in 2 tablespoonfuls of butter until they are soft without allowing them to brown. Add the yolks with salt, pepper, marjoram, and nutmeg, and stir in a cupful of sweet cream. Garnish the dish with the whites quartered.

Lemon Soufflé: Stir 4 yolks until they thicken, sweeten with saccharin, add the juice of half a lemon, some lemon rind grated, and 4 whites whipped stiff. Bake for ten minutes.

Wind Puffs: For 2 wind puffs stir 4 whole eggs, 2 tablespoonfuls of sweet cream, a pinch of salt, and a little saccharin, well for half an hour until the mixture is turned into a stiff froth. Pour into two buttered tins and bake in a hot oven for about half an hour. Serve hot with whipped cream.

Fish Scallops: 1 cupful of cooked fish freed from bone. Mix with 1 egg, capers, parmesan cheese, salt, and sour cream. Butter the scallops, fill in the mixture, sprinkle with powdered parmesan cheese, and bake in oven.

Cheese Soufflé: Grate 4 ounces of parmesan and 2⅓ ounces of Swiss cheese. Stir well with 4⅔ ounces of fresh melted butter, the yolks of 8 or 10 eggs and the whites beaten stiff. Season with ground white pepper and salt. Fill two small porcelain moulds, bake slowly for from ten to fifteen minutes, then serve quickly.

Cabbage Soufflé: Boil white cabbage in salt water. Chop fine, then stew with an onion and 1 pound of minced pork. Beat up 2 eggs with 6 or 8 spoonfuls of sour cream; whip 2 whites of egg; then stir the whole into the cabbage. Fill a buttered tin, sprinkle with parmesan cheese, and bake in the oven for one hour. Serve with tomato sauce.

Coffee or Orange Charlotte: ⅓ box of gelatin; ⅓ cupful of cold water; ⅓ cupful of boiling water; 3 tablespoonfuls of lemon juice; 1 cupful of orange juice and pulp or 1 cupful of coffee; and the whites of 3 eggs. Whip from 2 cupfuls of cream, saccharin to taste. Soak the gelatin in cold water and dissolve in boiling water; strain, and add to juice or coffee; chill the mixture in a pan of ice water; when quite thick beat with wire whisk until frothy, then add the whites of the eggs beaten stiff, and fold in cream. Turn into wet mould and chill.

Spanish Cream: ¼ box of gelatin; ¼ cupful of cold water; ¾ cupful boiling water; 3 eggs; ½ teaspoonful of salt; 1 pint of milk; vanilla, 1 teaspoonful; and saccharin to taste. Soak the gelatin in cold water, dissolve in boiling water. Make a custard with the yolks of the eggs beaten, and mixed with salt. Pour on the hot milk, and cook in double boiler until it thickens. Add the strained gelatin water, vanilla, saccharin, and the whites of the eggs beaten stiff. Mix well and turn into a mold wet in cold water. Place on ice until hard.

Boiled Custard: The yolks of 3 eggs; ½ teaspoonful of salt; 1 pint of hot milk; ½ teaspoonful of vanilla; and saccharin to taste. Scald the milk. Beat the yolks, add the salt, and the saccharin, and pour the hot milk slowly into the eggs; when well mixed, pour all back into the double boiler, and stir constantly until smooth and thick like cream; strain when cool, and add vanilla.

Snow Pudding: ¼ box of gelatin; ¼ cupful of cold water; 1 cupful of boiling water; ¼ cupful of lemon juice; the whites of 3 eggs, and saccharin to taste. Soak the gelatin in cold water, dissolve in boiling water, strain, add the lemon juice and saccharin, and set in ice water to cool. Stir occasionally. Beat the whites of the eggs to a stiff froth, and when the gelatin begins to thicken add the beaten whites and beat all together until very light; chill in a wet mould. Serve with boiled custard.

Coffee Jelly: ½ box of gelatin; ½ cupful of cold water; 1 cupful of boiling water; 3 cupfuls of coffee, and saccharin to taste. Soak the gelatin in cold water, dissolve in boiling water, and strain into sweetened coffee; pour into a wet mould and chill until firm. Serve with whipped cream.

Baked Custard: 1 quart of milk; 6 eggs; 1 teaspoonful of salt, and saccharin. Scald the milk. Beat the eggs, add the salt, and sweeten; then add the scalded milk. Strain, add a little nutmeg, and bake about twenty minutes in a dish set in a pan of warm water or in custard cups set in water.

Almond Cake: Beat ½ pound of butter and 8 egg-yolks vigorously for one-quarter hour. Mix 20 grams of baking powder, 100 grams of plasmon, lemon rind grated and the juice of 1 lemon, 1 teaspoonful of vanilla, and ¼ pound of finely chopped almonds, and add to the beaten yolks. Sweeten with saccharin, and lastly fold the 8 whites into the mixture and bake in well-buttered tin for one-half hour.

Chocolate Sauce: 1 tablespoonful of diabetic chocolate in a double boiler with ½ pint of milk, and 3 egg-yolks. Stir until it begins to thicken. When cold, add a pint of whipped cream.

Pudding a la Nesselrode: Stir 5 yolks over the fire with a little water until they thicken, add 7 ounces of finely chopped almonds, 9 tablespoonfuls of cognac, 1 tablespoonful of dissolved gelatin, and 15 whites whipped stiff. Fill into a mould rinsed with water.